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## CONDITIONING AND EXTINCTION AS A FUNCTION OF ANXIETY<sup>1</sup>

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In two previous experiments (6, 7) conducted in the Iowa laboratory, it was found that the level of performance in eyelid conditioning as measured by the frequency of CR's during the training period was definitely related to the scores made by the Ss on a manifest anxiety scale. Similar results have been obtained by other investigators (1, 4, 8, 9). A recent study by Hilgard, Jones, and Kaplan (2), however, failed to confirm this finding so far as the conditioning data were concerned. In a second part of their study involving differential conditioning a significant difference was obtained, Ss with high anxiety scores giving significantly more CR's to the negative stimulus than those with low anxiety scores.

The present experiment presents further data comparing the conditioning performances of anxious and nonanxious Ss. In addition to the frequency measure of conditioning, a measure of resistance to extinction was also available. After 60 conditioning trials the time interval between the CS and UCS was increased from 500 msec. to 2500 msec. McAllister (3) has recently demonstrated that the CR extinguishes (decreases) under this procedure, requiring just about as many trials to reach the level of response prior to conditioning as the number of trials involved in the

original conditioning. This technique has an advantage over the usual extinction procedure in defense conditioning in that it maintains the drive level of S. That is, S continues to receive the noxious UCS on all trials, but the CS-UCS interval is one that has been shown not to lead to conditioning.

### PROCEDURE

**SUBJECTS.**—Sixty-four Ss, 24 men and 40 women, from a course in introductory psychology served in the experiment. A number of other Ss were run in the situation but were eliminated because they failed to meet certain criteria which had been established in order to exclude Ss who made a high incidence of voluntary responses. As in an earlier experiment (6) the occurrence of 50% or more responses with latencies less than 300 msec. was taken as indicating a voluntary responder. Seven Ss, four from the nonanxious group and three from the anxious group were eliminated from the experiment on this basis.

Half of the Ss, 12 men and 20 women, constituted the anxious group. All of these Ss scored above the eightieth percentile on the manifest anxiety scale. The nonanxious Ss, also consisting of 12 men and 20 women, scored at the twenty-first percentile or lower on the scale.

**Apparatus and method of recording.**—The equipment for recording the eyelid closure and presenting the UCS was identical with that used in a previously reported study (5) and will not be described here.

The CS was a combination visual and auditory signal. The visual component consisted in an increase in the brightness of a 6-in. circular milk-glass disc from .05 apparent ft.-candles to 1.51 apparent ft.-candles. The auditory component was a 1000-cycle tone produced by a Hewlett-Packard oscillator. The duration of the CS on each trial during conditioning was 550 msec. with the UCS occurring 500 msec. after its onset. The duration of the UCS, an air puff of 1.0 lb./sq. in. pressure, was limited to 50 msec. by means of a 110-v., 60-cycle AC-operated solenoid valve controlled by an electronic timer. The time interval between the onset of the CS

<sup>1</sup>This study was carried out as part of a project concerned with the influence of motivation on performance in learning under contract N0001-93802, Project NR 154-107 between the State University of Iowa and the Office of Naval Research. The conditioning data were collected by Elaine Taylor.

and UCS in the extinction period was 2,500 msec.

**Conditioning and extinction.**—The experiment was conducted in a single period. Following the instructions each *S* received three presentations of the CS alone. A single presentation of the UCS was then administered and the response of the eyelid recorded for 40 sec. The *S* was given a ready signal, the word "ready," on each trial. He was instructed to blink once to this signal and then to look at the disc, attempting to remain as relaxed as possible. Following the thirtieth conditioning trial, *S* was reminded again to be as relaxed as possible and not to try to control his reactions to the CS or UCS.

Sixty conditioning trials were given in all with the ninth or tenth trial of each successive block of ten trials being a test trial. No UCS was administered on these trials. The inter-trial interval averaged 20 sec., with intervals of 15, 20, and 25 sec. being employed in a random sequence.

A total of 40 extinction trials was given immediately following the completion of the conditioning trials. During this period the UCS was given on every trial but at an interval of 2,500 msec. following the onset of the CS. Responses occurring between 150 and 500 msec. following the CS were recorded as CR's during this period. Intertrial intervals of 20 and 25 sec. were used. At the end of the session all *S*s were questioned as to the purpose of the experiment and warned not to discuss the experiment with other members of the class. An interesting sex difference was revealed in the ability of the *S*s to identify correctly the experiment as being concerned with conditioning. Whereas 66.7% of the men were able to identify the experiment, only 17.5% of the women were able to do so. The experiment was conducted late in the afternoon of the week after conditioning had been completed in class.

## RESULTS AND DISCUSSION

**Anxiety level and conditioning.**—The mean numbers of CR's exhibited in

TABLE 2

ANALYSIS OF VARIANCE FOR NUMBER OF CR'S IN 60 TRIALS

Source	<i>df</i>	Mean Square	<i>F</i>
Anxiety	1	1251.39	4.51*
Sex	1	914.55	3.30
A × S	1	14.75	
Within groups	60	277.53	
Total	63		

\* Significant at the .05 level.

the 60 conditioning trials are shown in Table 1. It will be seen that in both the male and female groups the anxious *S*s gave a larger number of CR's than the nonanxious *S*s. The results of an analysis of variance of these data are summarized in Table 2. It will be noted that the *F* for the anxious-nonanxious condition was 4.51, which is significant at a confidence level below .05. The *F* for sex was not significant at the .05 level but was at less than the .10 level of confidence.

**Anxiety level and extinction.**—Table 3 presents the data on extinction in terms of the number of CR's made in the 40 trials. It is apparent that the anxious groups show a higher level of response than the nonanxious groups. Table 4 gives the analysis of variance of these data. Once again the *F* between the anxious and nonanxious groups is significant at better than the .05 level of confidence. Unlike the data for the conditioning period, how-

TABLE 1

MEAN NUMBER OF CR'S IN 60 CONDITIONING TRIALS

Sex	<i>N</i>	Anxious		Nonanxious	
		Mean	<i>σ<sub>M</sub></i>	Mean	<i>σ<sub>M</sub></i>
Male	12	25.1	4.24	15.0	4.43
Female	20	31.9	3.95	23.8	3.92

TABLE 3

MEAN NUMBER OF CR'S IN 40 EXTINCTION TRIALS

Sex	Anxious		Nonanxious	
	Mean	<i>σ<sub>M</sub></i>	Mean	<i>σ<sub>M</sub></i>
Male	11.7	3.01	8.42	3.23
Female	15.2	2.33	9.10	2.19

TABLE 4  
ANALYSIS OF VARIANCE FOR NUMBER OF  
CR'S IN EXTINCTION

Source	df	Mean Square	F
Anxiety	1	606.39	5.62*
Sex	1	5.55	
A × S	1	.08	
Within groups	60	107.98	
Total	63		

\* Significant at < .05 level.

ever, the extinction data show little indication of a sex difference.

*Comparison with earlier study.*—A comparison of the data of the present study with comparable conditioning measures from an earlier study is interesting for the degree of stability shown from one study to the other. Spence and Taylor (6) conducted an experiment in the same physical situation and under approximately the same CS-UCS time interval (500 and 520 msec.). The CS differed in the two studies in that a 1000-cycle tone was given in the present experiment in addition to the visual stimulus, which was identical with that in the first study. Two levels of the UCS were employed in the earlier study, one consisting of a pressure of approximately .6 lb./sq. in. and the other 2.0 lb./sq. in. The UCS in that instance was produced by a column of mercury falling in a manometer. In

this type of system there is a rapid decrease in the magnitude of pressure and the duration is approximately 400 msec. The strength of the air pressure used in the present study was 1.0 lb./sq. in. and the pressure was maintained at a fairly constant level for 50 msec.

Table 5 provides the comparative data in terms of the number of CR's occurring in 60 conditioning trials. In both the men and the women, the anxious Ss are in each comparison superior in level of conditioning to the nonanxious Ss. On the assumption that Ss from the anxious and nonanxious groups are drawn from the same population one would expect, according to the binomial expansion, to obtain six differences in the same direction only 1.56% of the time. Taken in conjunction with the original study by Taylor (7) the evidence for a genuine difference in the level of response in conditioning between anxious and nonanxious Ss is very strong. It should be noted, however, that this study and the study by Spence and Taylor (6) were careful to control for voluntary responders. In small groups of ten Ss or less a disproportionate number of such Ss in one or the other of the comparison groups would greatly affect the difference that would be obtained.

There was a consistent sex differ-

TABLE 5  
MEAN NUMBER OF CR'S IN 60 TRIALS FOR ANXIOUS AND NONANXIOUS Ss  
IN THREE EXPERIMENTS

Study	UCS in lb./sq. in.	Men			Women		
		N(Pairs)	Anxious	Nonanxious	N(Pairs)	Anxious	Nonanxious
Spence & Taylor (6)	.6	15	22.0	13.5	10	25.3	17.2
Present Study	1.0	15	25.1	15.3	10	30.0	22.2
Spence & Taylor (6)	2.0	12	22.1	15.0	20	30.8	23.3
Combined		42	22.9	14.5	40	30.0	22.2

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ence in all three subexperiments, the women Ss responding at a higher frequency level than the men. Again all six appropriate comparisons come out in the same direction. This finding suggests that in these extreme groups on the anxiety scale the women show a significantly higher level of response in the conditioning situation than the men.<sup>2</sup> One possible interpretation of this finding is that the situation (novelty and strangeness of the experimental setup) arouses greater fear or anxiety in women than in men and hence women have a higher drive (*D*) level during the course of the experiment.

## SUMMARY

Two groups of 32 Ss, selected on the basis of extreme scores made on a test of manifest anxiety, were conditioned for 60 trials and then given 40 "extinction" trials in which the CS-US interval was increased to one which has been shown to be nonconductive to human eyelid conditioning.

The results indicated that there was a significant difference ( $p < .05$ ) in performance level both during conditioning and extinction for the two groups of anxious

and nonanxious Ss. The findings also suggested that in these extreme groups on the anxiety scale women perform at a higher level than men. There was no indication of a difference between men and women in the extinction series.

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<sup>2</sup> The Mann-Whitney test was used to test the hypothesis that there was no difference with respect to the distribution of scores of anxious men and women (the three sets of experimental data were combined since the differences among them were nonsignificant). The  $z$  value obtained was 1.92, which is significant at approximately the .05 level of confidence for a single-tailed hypothesis. A similar calculation for the non-anxious Ss indicated that the hypothesis of no difference between men and women distributions could be rejected at about the same level of confidence ( $z = 1.97$ ).